GCDB INTEGRATION PROJECT REPORT

PREPARED FOR FLATHEAD COUNTY
FALL 2006

DJ&A, P.C.

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Project Background

What, When, Where, Why

Flathead County was the first county in Montana to use the Bureau of Land Management's Geographic Coordinate Database (GCDB) as the basis for parcel mapping. The county began its GIS parcel mapping work in the 1990's, prior to the BLM developing a GCDB for that part of the state. The county performed field mapping of Public Lands Survey Systems (PLSS) corners in order to obtain reliable coordinate values for the county version of the GCDB. Over time, the county mapped the entire extents of its parcel (land ownership boundary) layers. During the county's mapping process, the BLM developed its official version of the GCDB for the area of Flathead County. These two versions of the GCDB were never reconciled into a single version. Thus, the county had its parcels based on an unofficial version of the GCDB. Meanwhile, the State of Montana Cadastral Project mapped (most of) the rest of the state by using the BLM's official version of the GCDB. The two separate paths resulted in Flathead County data being slightly discontinuous with the parcel data for the rest of the state (particularly with respect to adjacent counties).

This project was an effort to reconcile the two GCDB by determining which version was the better and more spatially accurate digital representation of the PLSS in Flathead County, and using that version as the official version of the GCDB, and if necessary, adjust the county's parcel layers to that official version.

Who

The Flathead County Geographic Coordinate Database (GCDB) Integration Project was a partnership project of the County of Flathead; The US Department of the Interior, Bureau of Land Management; Montana Department of Administration, Information Technology Services GIS Bureau, and DJ&A, PC - a private engineering, surveying, and mapping company.

The project occurred during the late summer and through the fall of 2006 and focused on the extents of the Flathead County Geographic Coordinate Database coverage (see attached map "Project Area").

How,

The general process was to review the county GCDB data for consistency, correct content, and spatial accuracy as compared to the BLM version, using accepted land survey methods for review and analysis.

I. Project Problem statement

a. Issues

Duplicate version of what should be the same data set presents problems of duplication of effort in some areas, and additional re-working of data for data integration and data maintenance efforts, such as when new data must be incorporated into the state-wide cadastral GIS layer. Cost savings can be realized by reducing the amount of work required to update and maintain the GCDB and parcel data from the county to the state.

b. Goals & Objectives

The primary objectives were to review the existing Flathead County Geographic Coordinate Database (GCDB) for incorporation into the Montana Spatial Data Infrastructure (MSDI) GCDB of the Bureau of Land Management and to move the Flathead County parcel data to the Montana Cadastral Standard.

c. Project Area Status maps - attached

1. BLM GCDB Accuracy by Township
2. Project area
3. Parcel Density
4. Population Density
5. Built Environment (e.g. structure density)

II. Approach used

a. Methods, Options, Procedures to Used for Enhancement

The process used was to review the Flathead County GCDB data for form and content, and to examine in detail a sample of the data for accuracy. Copies of the county GCDB were obtained and reviewed by a licensed land surveyor in consultation with the Bureau of Land Management GCDB surveyor.
Field checks were performed on a sampling of townships PLSS corners using survey grade GPS to check the county reported accuracy of the GCDB coordinate values.

The following tasks were performed

- Detailed review and field test of a 10% sampling (10 townships);
- Make corrections and adjustments, if necessary, to the sample townships;
- Ensured the proper format all data and submit to the BLM;
- (No parcel adjustment was necessary);
- Report on the results.

III. Results Discussion

a. GCDB Data Review

Content & Form

This section contains the township-by-township reports and observations and recommendations of Kurt Luebke, PLS based on a detailed review of the ten townships that were selected for close scrutiny.

T27NR19W

This township was prepared by Rick Breckenridge at some time in the past for Flathead County. At this time the files were checked by Kurt Luebke of DJ&A, P.C. to prepare them for acceptance by the BLM. The following items were noted and recommendations are listed below.

1) I visually compared the two GCDB files for any blatant problems, none were found at this point.

2) The survey sid files were compared for any missing, additional or problem surveys, with the following items:

   a. The county codes for private surveys in the BLM files are incorrectly entered as Lake and Fergus Counties. The Flathead entries are correct.
   b. There is a 1960 protraction diagram which was entered by Rick, which is not found in the BLM files.
   c. There is a statement on C COS488 for the Flathead data which states; "sid created during .raw file read". I'm not sure that any action needs to take place for this.
   d. C S31198 for the BLM seems to show up as C S488 in the Flathead sid. I'm not sure that any action needs to take place for this.

3) The BLM has abstracted 103 private surveys, while the Flathead data includes 119 Surveys.

4) I checked the .RCL file and did not see any dangling corners.

5) Visual inspection of the Parcels seemed to show no problems.

6) There are 13 resource grade corner ties in the Flathead data, which is a large improvement over the 6 USGS corner positions in the BLM data.

Recommendations are to:

1) Check and update the Flathead data, using the BLM data, in section 1 where the protraction was used. This would be for a couple lines.

2) Update the Flathead data with the BLM parcel data (.iid and .an files).

3) Upon the updating of these files by the BLM, the Flathead data would be used by the BLM.

T27NR20W

This township was prepared by Rick Breckenridge at some time in the past for Flathead County. At this time the files were checked by Kurt Luebke of DJ&A, P.C. to prepare them for acceptance by the BLM. The following items were noted and recommendations are listed below.

1) I visually compared the two GCDB files for any blatant problems, none were found at this point.

2) The survey sid files were compared for any missing, additional or problem surveys, with the following items:

    a. The county codes for private surveys in the BLM files are incorrectly entered as Lake and Fergus Counties. The Flathead entries are correct.

3) The BLM has abstracted 15 private surveys, while the Flathead data includes 78 Surveys.

4) I checked the .RCL file and found the following dangling corners.
    1) 324700 and 332700; 332700 needs to be renumbered to 324700
    2) 600520 – The N-S line needs to be split.
    3) 340600 – The E-W line needs to be split.
    4) 540440 – This is a dead end line and can be left alone.

5) Visual inspection of the Parcels seemed to show no problems.

6) There are 11 resource grade corner ties in the Flathead data along with 3 USGS corner positions, which is a large improvement over the 3 USGS corner positions in the BLM data.

Recommendations are to:

1) Check and update the Flathead data, making the 3 edits above.

2) Update the Flathead data with the BLM parcel data (.iid and .an files).

3) Upon the updating of these files by the BLM, the Flathead data would be used by the BLM.

T27NR24W

This township was prepared by Rick Breckenridge at some time in the past for Flathead County. At this time the files were checked by Kurt Luebke of DJ&A, P.C. to prepare them for acceptance by the BLM. The following items were noted and recommendations are listed below.

1) I visually compared the two GCDB files for any blatant problems, none were found at this point.

2) The survey sid files were compared for any missing, additional or problem surveys, with none found.

3) The BLM has abstracted 0 private surveys, while the Flathead data includes 54 Surveys.

4) I checked the .RCL file and found one dangling corner; this is corner 200600. This corner comes from calculations in COS 4154, this corner does not exist due to falling in a lake. I believe that this line could be removed.

5) Visual inspection of the Parcels seemed to show no problems.

6) There are 6 resource grade corner ties along with 19 USGS ties in the Flathead data, which is an improvement over the 19 USGS corner positions in the BLM data.

Recommendations are to:

1) Check and update the Flathead data, one possible update from the corner in the lake.

2) Update the Flathead data with the BLM parcel data (.iid and .an files).

3) Upon the updating of these files by the BLM, the Flathead data would be used by the BLM.

T28NR21W

This township was prepared by Rick Breckenridge at some time in the past for Flathead County. At this time the files were checked by Kurt Luebke of DJ&A, P.C. to prepare them for acceptance by the BLM. The following items were noted and recommendations are listed below.

1) I visually compared the two GCDB files for any blatant problems, and the LXN lines in section 7 were skewed into section 8. Upon inspection of the sids in that area I found that there were two incorrectly named corners from COS11562. The first line is from 140540 to 200540; in which the 140540 should be 240540. The second line is from 300540 to 140540; in which the 140540 should also be 240540.

2) The survey sid files were compared for any missing, additional or problem surveys, with none found.

3) The BLM has abstracted 0 private surveys, while the Flathead data includes 108 Surveys.

4) I checked the .RCL file and found two dangling corners; 357100 and 257100. I believe that 257100 should be removed or renamed to 357100.

5) Visual inspection of the Parcels seemed to show no problems.

6) There are 18 resource grade corner ties along with 25 USGS ties in the Flathead data, which is an improvement over the 5 USGS corner positions in the BLM data.

Recommendations are to:

1) Check and update the Flathead data:
    a) fix two miss-named lines
    b) Rename 257100 to 357100

2) Update the Flathead data with the BLM parcel data (.iid and .an files).

3) Upon the updating of these files by the BLM, the Flathead data would be used by the BLM.

T29NR21W

This township was prepared by Rick Breckenridge at some time in the past for Flathead County. At this time the files were checked by Kurt Luebke of DJ&A, P.C. to prepare them for acceptance by the BLM. The following items were noted and recommendations are listed below.

1) I visually compared the two GCDB files for any blatant problems; the lines looked good.

2) The survey sid files were compared for any missing, additional or problem surveys, with none found.

3) The BLM has abstracted 0 private surveys, while the Flathead data includes 109 Surveys.

4) I checked the .RCL file and found no dangling corners.

5) Visual inspection of the Parcels seemed to show no problems.

6) There are 12 resource grade corner ties along with 5 USGS ties in the Flathead data, which is an improvement over the 5 USGS corner positions in the BLM data.

Recommendations are to:

1) Check and update the Flathead data.

2) Update the Flathead data with the BLM parcel data (.iid and .an files).

3) Upon the updating of these files by the BLM, the Flathead data would be used by the BLM.

T30NR21W

This township was prepared by Rick Breckenridge at some time in the past for Flathead County. At this time the files were checked by Kurt Luebke of DJ&A, P.C. to prepare them for acceptance by the BLM. The following items were noted and recommendations are listed below.

1) I visually compared the two GCDB files for any blatant problems; the lines looked good.

2) The survey sid files were compared for any missing, additional or problem surveys, with none found.

3) The BLM has abstracted 0 private surveys, while the Flathead data includes 142 Surveys.

4) I checked the .RCL file and found no dangling corners. There are duplicate lines caused by the input of COS10915 twice; the second input is incorrectly named COS10195 in the sid. This is a COS for T27N R20W. This sid should be deleted.

5) Visual inspection of the Parcels seemed to show no problems.

6) There are 11 resource grade corner ties along with 8 USGS ties in the Flathead data, which is an improvement over the 9 USGS corner positions in the BLM data.

Recommendations are to:

1) Check and update the Flathead data; after removing sid COS10195.

2) Update the Flathead data with the BLM parcel data (.iid and .an files).

3) Upon the updating of these files by the BLM, the Flathead data would be used by the BLM.

T31NR19W

This township was prepared by Rick Breckenridge at some time in the past for Flathead County. At this time the files were checked by Kurt Luebke of DJ&A, P.C. to prepare them for acceptance by the BLM. The following items were noted and recommendations are listed below.

1) I visually compared the two GCDB files for any blatant problems; there are surveys in the Flathead data along the East side of the township that do not show up in the BLM file.

2) The survey sid files were compared for any missing, additional or problem surveys, with the following comments:

    a. In the flathead data I see a sid for a BLM surey in 1960 by Clemet, but the BLM did not abstract this data.
    b. The 1905 meanders by Mclain have different survey #'s in each of the data sets.
    c. The 1952 survey by Bandy has a different survey # in each of the data sets.
    d. The 1987 survey by Baxter has a different survey # in each of the data sets.
    e. Flathead county data set is missing the three 1996 BLM surveys by Baxter.

3) The BLM has abstracted 0 private surveys, while the Flathead data includes 59 Surveys.

4) I checked the .RCL file and found no dangling corners.

5) The parcels are not created in the Flathead data, upon running the VerIID program I saw some differences between the Flathead and BLM especially in section 12.

6) There are 6 resource grade corner ties along with 8 USGS ties in the Flathead data, but there is 5 survey grade corners and 14 USGS ties in the BLM control file.

Recommendations are to:

1) The Flathead data needs:
    a. Have the 1996 BLM surveys abstacted.
    b. Possibly have the 1960 BLM survey by Clemet removed.
    c. Possibly have the sid numbers changed for the 3 surveys mentioned above.
    d. Update the BLM control file with the following corners:
    e. 700700,100540,140300,200100,400300,697100 from the Flathead control file; and then use this control file to update the Flathead data.

2) Update the Flathead data with the BLM parcel data (.iid and .an files); it would need to be determined if the BLM parcels are more correct.

3) Upon the updating of these files by the BLM, the Flathead data would be used by the BLM.

T31NR22W

This township was prepared by Rick Breckenridge at some time in the past for Flathead County. At this time the files were checked by Kurt Luebke of DJ&A, P.C. to prepare them for acceptance by the BLM. The following items were noted and recommendations are listed below.

1) I visually compared the two GCDB files for any blatant problems; the lines looked good.

2) The survey sid files were compared for any missing, additional or problem surveys, with none found.

3) The BLM has abstracted 0 private surveys, while the Flathead data includes 77 Surveys.

4) I checked the .RCL file and found no dangling corners.

5) Visual inspection of the Parcels showed 2 water parcels as lots.

6) There are 16 resource grade corner ties along with 17 USGS ties in the Flathead data, which is an improvement over the 17 USGS corner positions in the BLM data.

Recommendations are to:

1) Check and update the Flathead data.

2) Update the Flathead data with the BLM parcel data (.iid and .an files).

3) Upon the updating of these files by the BLM, the Flathead data would be used by the BLM.

T31NR23W

This township was prepared by Rick Breckenridge at some time in the past for Flathead County. At this time the files were checked by Kurt Luebke of DJ&A, P.C. to prepare them for acceptance by the BLM. The following items were noted and recommendations are listed below.

1) I visually compared the two GCDB files for any blatant problems; the lines looked good.

2) The survey sid files were compared for any missing, additional or problem surveys, with none found.

3) The BLM has abstracted 0 private surveys, while the Flathead data includes 48 Surveys.

4) I checked the .RCL file and found the following dangling corners:

   a. 570120 – which can be fixed by splitting 600100 – 600140
   b. 600120 – which can be fixed by splitting 600100 – 600140
   c. 160400 – which can be fixed by splitting 200400 – 140400
   d. 620200 – which can be fixed by splitting 640200 – 600200
   e. 600160 – which can be fixed by splitting 600140 – 600200

5) Visual inspection of the Parcels showed no problems.

6) There are 7 resource grade corner ties along with 15 USGS ties in the Flathead data, which is an improvement over the 18 USGS corner positions in the BLM data.

Recommendations are to:

1) Check and update the Flathead data after fixing the dangling lines.

2) Update the Flathead data with the BLM parcel data (.iid and .an files).

3) Upon the updating of these files by the BLM, the Flathead data would be used by the BLM.

T36NR22W

This township was prepared by Rick Breckenridge at some time in the past for Flathead County. At this time the files were checked by Kurt Luebke of DJ&A, P.C. to prepare them for acceptance by the BLM. The following items were noted and recommendations are listed below.

1) I visually compared the two GCDB files for any blatant problems; the lines looked good.

2) The survey sid files were compared for any missing, additional or problem surveys. The Flathead surveys seem to be incomplete, misnamed and out-dated.

3) I checked the .RCL file and found the following dangling corner:

    a. 812033 – No fix required.

4) Parcel polygons will not load.

5) There are 11 resource grade corner ties in the Flathead data, while there are 3 USGS corner positions and 11 survey grade corners in the BLM data.

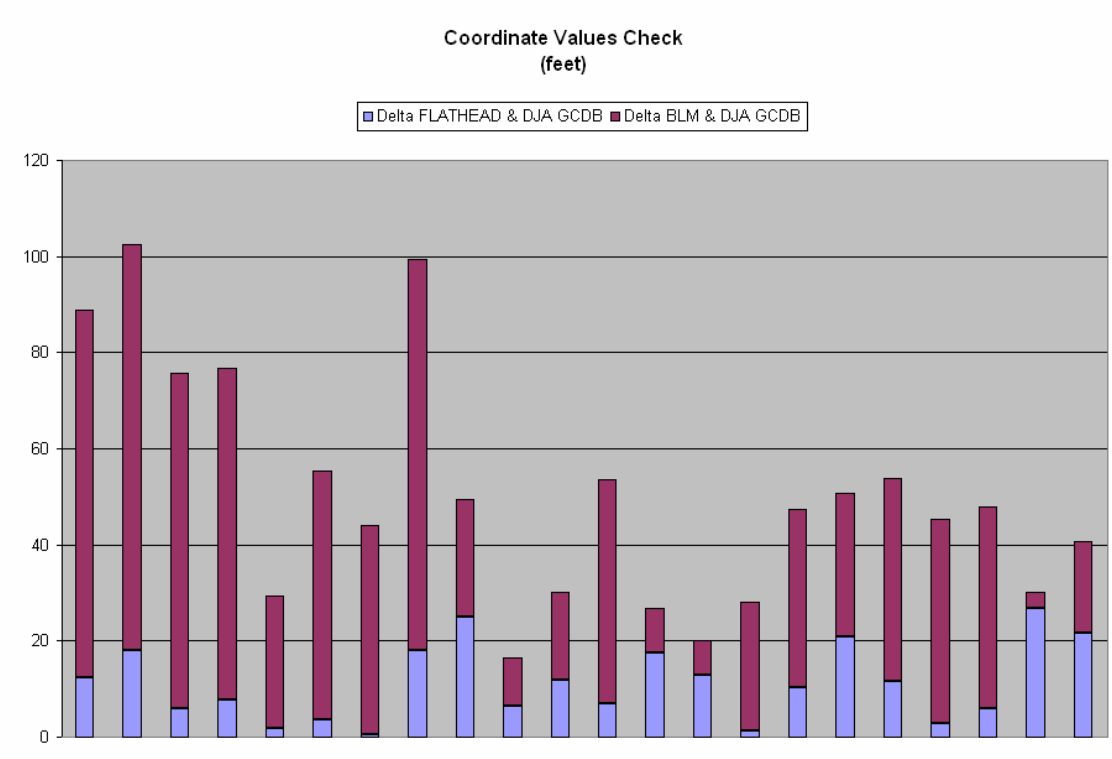
Recommendations are to:

1) Update the BLM control file with the 11 resource Flathead control corners.

2) Keep the existing BLM GCDB data set.

Spatial Accuracy

The chart below shows the magnitude of the differences between the DJ&A GPS coordinates and the Flathead County GCDB coordinates versus the difference between the DJA GPS coordinates and the BLM GCDB coordinates for the sample townships that we checked (DJA-Flathead vs. DJA-BLM). The smaller the bar, the better the GCDB coordinates value.



These data show that Flathead County's GCDB has superior accuracy compared to the BLM's. Overall, the Flathead GCDB coordinate values average 6-7 times better than the BLM's, although there were a few where the BLM value was better.

The following chart compares the Flathead County GCDB coordinate values to the DJA surveyed coordinate for the sample data set.

Error Statistics	*Value (ft)*
average	11.36
min	0.53
max	26.69
std dev	7.86

These are excellent numbers. Flathead County probably has the most spatially accurate GCDB in the state.

b. Parcels Adjustment

The accuracy of the County GCDB means that no new adjustment is necessary upon the BLM replacing its GCDB with the County's. Therefore the County parcel layer and all other GIS layers related to the parcels and/or GCDB, will not need to be adjusted, except in those townships where the BLM has more recent data. However slight movement of the cadastral data may occur, although the effect should be trivial.

IV. Conclusions

The Flathead County GCDB is properly formatted and spatially more accurate than the majority of the BLM version of GCDB. The data are acceptable to the BLM in their present format. Because the Flathead County GCDB coordinates are more accurate than the BLM's, and the Flathead County data are for the most part complete and formatted correctly, the BLM can and shall swap in the County's version for the BLM's present version (except in those few townships where the BLM has more recent data). There may be some additional quality edits required in some areas, but the BLM is generally satisfied with the Flathead County data and will incorporate most of the data created by the county.

While the BLM will accept the Flathead County GCDB the relation between the Flathead County parcels and the Flathead County GCDB should be examined to validate whether or not any errors were introduced over time.

V. Further Recommendations

Incorporating the current Flathead County Data into the BLM's GCDB

The BLM has agreed to incorporate the Flathead County GCDB into the BLM GCDB where the county version is more spatially accurate. Those townships that the BLM developed after the county had completed its work are the only available GCDB for those townships and there were a couple townships were the BLM had more recent data. The BLM will use the more recent and complete data in those townships. The Montana Cadastral Mapping Program should find no major issues with the Flathead County GCDB data.

The remaining steps for incorporating the Flathead County GCDB into the MSDI cadastral layer are as follows.

1. The BLM will pull the county's GCDB from the county FTP site.
2. The BLM will inspect each GCDB township for major errors and make any necessary corrections (estimated time is 1 hour per township for the approximately 86 townships).
3. Some County GCDB will swap right into (i.e. replace) the BLM GCDB,
4. Some townships the BLM has more recent information,
5. Some County townships will require some edits before they can be inserted.
6. The edit and review work required to do this is within the capabilities of existing BLM staff skills and availability within the next couple months.
7. Premier Data Services must run the FIXLX process (edge-matching, fix slivers, etc.) after the BLM inputs the data and does the regional adjustment.
8. The Montana GIS Bureau will adjust the cadastral layer. Note: typically some minor movement of County parcels will occur as a final step. The specific process for the this step must be worked out in detail between the state and the county in order to ensure a smooth work flow that does not interrupt on-going county parcel maintenance.
9. The county may need to perform some adjustments to other dependent GIS layers.

The time frame for completion of these steps is by the early February 2007.

Step	Who	JAN (07)				FEB (07)					MAR (07)	
		Wk 2	Wk 3	Wk 4	Wk 5	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 1	Wk 2
Incorporate Flathead County GCDB into BLM GCDB	BLM											
Run edgematching & cleanup (FIXLX)	Premier Data Services											
Adjust cadastral - low density townships	MT GIS Bureau											
Adjust cadastral - high density townships	MT GIS Bureau											
Incoprate new low density parcels into county dataset	Flathead County											
Incoprate new high density parcels into county dataset	Flathead County											

A more detailed timeline for the parcel adjustment steps will be worked out between the state and the county.

Future adjustments to the Flathead County GCDB and parcels.

When the county identifies areas where the spatial accuracy of the parcels is inadequate to meet its business requirements, the county should contact the state GIS Bureau to discuss methodologies to use (e.g. GCDB or non-GCDB adjustments). In all likelihood the county could continue to use GCDB based township adjustments effectively. These adjustments should be done on a township basis, that is, even if the area to adjust is small, the entire township that it is in, should be adjusted. This is the BLM's process.

The GCDB based adjustments would involve the county performing field surveys of PLSS corners, and/or incorporating survey data (plats and/or surveys) record bearing and distance measurements between PLSS corners to develop new coordinate positions for GCDB corners.

If GCDB based adjustments ever fail to meet the spatial accuracy requirements of the city, the city may elect to red-line a township or multiple townships in order to use non-GCDB based control and adjustment methods. This is done in urban areas in other parts of the state (e.g. Helena and Billings). The BLM & state GIS Bureau can provide guidance on this process if the need arises.

END OF DOCUMENT